Test Friday, 11/18

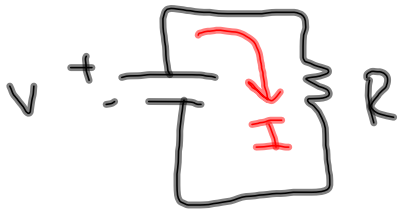
Electrostatics

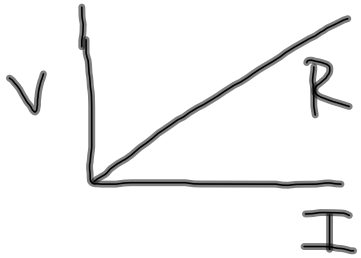
Circuits

• Resistance:

- Factors that affect:
  - Material
  - Length
  - Cross-sectional area (relates to radius)
  - Temperature

• Ohm's Law:

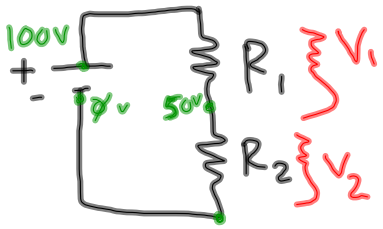




$$V = IR$$

- Ohmic materials follow this. (resistors, wires, etc.)
- Non-ohmic materials do not follow (light bulbs)

• Equivalent Resistance:



$R_{eq} = R_1 + R_2 + \ldots$

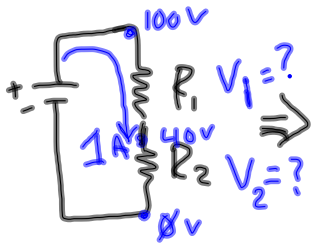
if $R_1 = R_2$

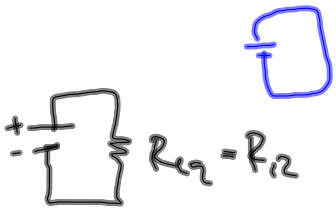
these are voltage drops

• Kirchoff's Law:

1. All V is used up when completing any loop in a circuit.

2. Sum of currents leaving a junction is equal to the current coming into a junction.





$V = 100\,V$

$R_1 = 60\,\Omega$

$R_2 = 40\,\Omega$

$V_{total} = I_{total} R_{eq}$

$I_{total} = \frac{V_{total}}{R_{eq}}$

$= \frac{100\,V}{100\,\Omega}$

$= 1\,A$

$V_1 = I_{total} R_1$

$= (1\,A)(60\,\Omega)$

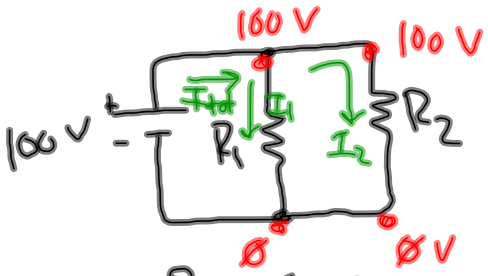
$= 60\,V$

$V_2 = I_{total} R_2$

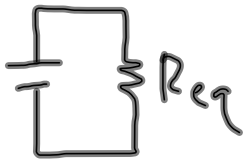
$= (1\,A)(40\,\Omega)$

$= 40\,V$

- Parallel:



$\Rightarrow$



$R_1 = 60\,\Omega$

$R_2 = 40\,\Omega$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$$

$$R_{eq} = \left[\frac{1}{60\Omega} + \frac{1}{40\Omega}\right]^{-1}$$

$$= 24\,\Omega$$

$$V_{total} = I_{total} R_{eq}$$

$$I_{total} = \frac{100\,V}{24\,\Omega}$$

$$= 4.2\,A$$

$$V_{total} = I_1 R_1$$

$$I_1 = \frac{100\,V}{60\,\Omega}$$

$$= 1.67\,A$$

$$V_{total} = I_2 R_2$$

$$I_2 = \frac{100\,V}{40\,\Omega}$$

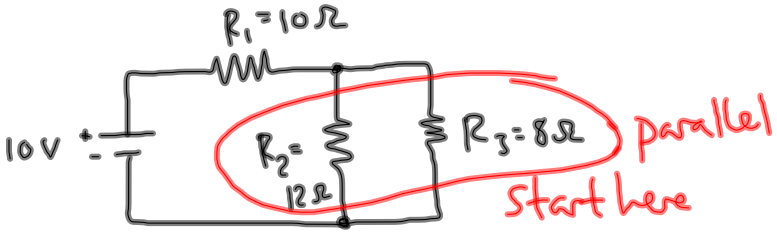
$$= 2.5\,A$$

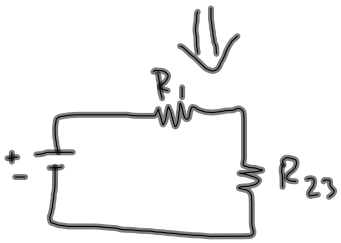
Kirchoff's law:

$$I_{total} = I_1 + I_2$$

$$4.17\,V = 1.67\,V + 2.5\,V = 4.17\,V \checkmark$$

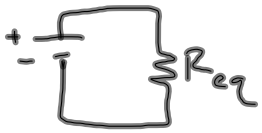
• Complex Circuits:





$$\frac{1}{R_{23}} = \frac{1}{R_2} + \frac{1}{R_3}$$

$$R_{23} = 4.8\,\Omega$$



$$R_{eq} = R_1 + R_{23}$$
$$= 14.8$$

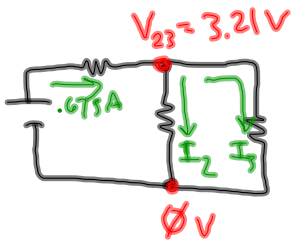
$$V_{total} = I_{total} R_{eq}$$

$$I_{total} = \frac{10\,V}{14.8\,\Omega}$$

$$= 0.675\,A$$

... working backwards

$$V_1 = I_{tot} R_1 \qquad V_{23} = I_{total} R_{23}$$
$$= 6.75\,V \qquad = 3.21\,V$$



$$V_{23} = I_2 R_2 \qquad V_{23} = I_3 R_3$$

$$I_2 = \frac{3.21\,V}{12\,\Omega} \qquad I_3 = \frac{3.21\,V}{8\,\Omega}$$

$$= 0.27\,A \qquad = 0.41\,A$$